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RESEARCH ARTICLE

New records on distribution and habitat of the lesser long-nosed bat (*Leptonycteris yerbabuenae*) in Honduras

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Abstract

The lesser long-nosed bat (*Leptonycteris yerbabuenae* Martínez & Villa-R, 1940) is a specialized nectar feeding species found from southern USA to Nicaragua in Central America, mostly in dry forest. We sampled bats using mist nets and Anabat detectors, and also looked for them at refuges and other sites in Honduras from 2011 to 2016. The lesser long-nosed bat is known in Honduras from only two localities in the southern dry forests below 100 m elevation, and there are no recent records of this species in the country. Our objective is to report new records on distribution and habitat of the lesser long-nosed bat in Honduras. We found eight lesser long-nosed bats at Cerro de Hula, Francisco Morazán department in 2012, and 10 at La Anonilla, Choluteca department, southern Honduras in 2015. Based on these 18 individuals of the lesser long-nosed bat, we report two new localities in Honduras, an altitude record, and the use of another habitat other than the dry forest. The highest point registered was at 1710 m a.s.l. in pastureland with forest remnants in an area heavily impacted by human activities. The new localities are found in the Subtropical Moist Forest. Populations of long-nosed bats in Honduras are probably resident and may include altitudinal movements. Although this species has been described widely in North America, its behavior in Honduras is practically unknown. It is a key species

for the tequila and mezcal industry, but its range extends beyond the tequila production area, where it maintains a key role as a pollinator and link between habitats. As a result, research and conservation efforts should be an international goal.

Keywords
Choluteca, dry forest, Francisco Morazán, Nacaome, nectar feeding bat, Phyllostomidae, Subtropical moist forest

Introduction

The lesser long-nosed bat (*Leptonycteris yerbabuenae* Martínez & Villa-R, 1940) is a phyllostomid species that extends from southern Arizona and New Mexico (USA), through most of Mexico south to Chiapas and to the pacific versant of Nicaragua in Central America (Medellín 2019; Saldaña Tapia et al. 2020). In Central America the species has been reported from Guatemala (Arita and Humphrey 1988), El Salvador (Jones and Bleier 1974), Honduras (Lee and Bradley 1992), and Nicaragua where it was found recently (Saldaña Tapia et al. 2020). The species has been reported from only two localities in Honduras (Turcios-Casco et al. 2020). These last authors emphasized that there are no recent records of this species in the country. However, a third locality (at Francisco Morazán department) was included in figure 2 of Saldaña-Tapia et al. (2020). The lesser long-nosed bat occurs from lowlands to 2,500 m elevation, usually below 1,000 m (Medellín 2019). The lesser long-nosed bat is widespread and abundant in Mexico (Arita and Santos del Prado 1999), but it is generally uncommon in southeastern Mexico and Central America (Reid 2009), and it is rare in Honduras (Mora et al. 2018). This species inhabits dry tropical and desert habitats including deciduous and mixed forests, but it can be found in other ecosystems (Arita and Humphrey 1988; Arita 1991; Medellín 2019). The species feeds on nectar and pollen from cacti and agaves but also visits trees in the Malvaceae family (Mora et al. 2018), and consumes soft fruits of cacti and other plants (Medellín 2019). Fruits are an important part of the diet of this bat, and it is probably an important disperser of seeds in dry environments in Southern and Central Mexico (Rojas-Martínez et al. 2012).

A high percentage of the distribution range of the lesser long-nosed bat coincides with the distribution of the mezcal plant (*Agave angustifolia*) in México (Arita 1991). There is a close relationship between these two species, so the lesser long-nosed bat is a keystone mutualist and also it is a key mobile link between habitats (Menchaca et al. 2020). This relationship has very important economic implications (Menchaca et al. 2020). However, it has been suggested that due to the biological features associated with the specialized diet, nectar-feeding bats might be more vulnerable to extinction than other bats (Arita and Santos del Prado 1999).

Although the species has shown evidence of some recovery in recent decades, it is classified as threatened (Medellin 2019) due to over-exploitation, shrinking distribution, and habitat destruction and degradation (Medellin 2016). The species

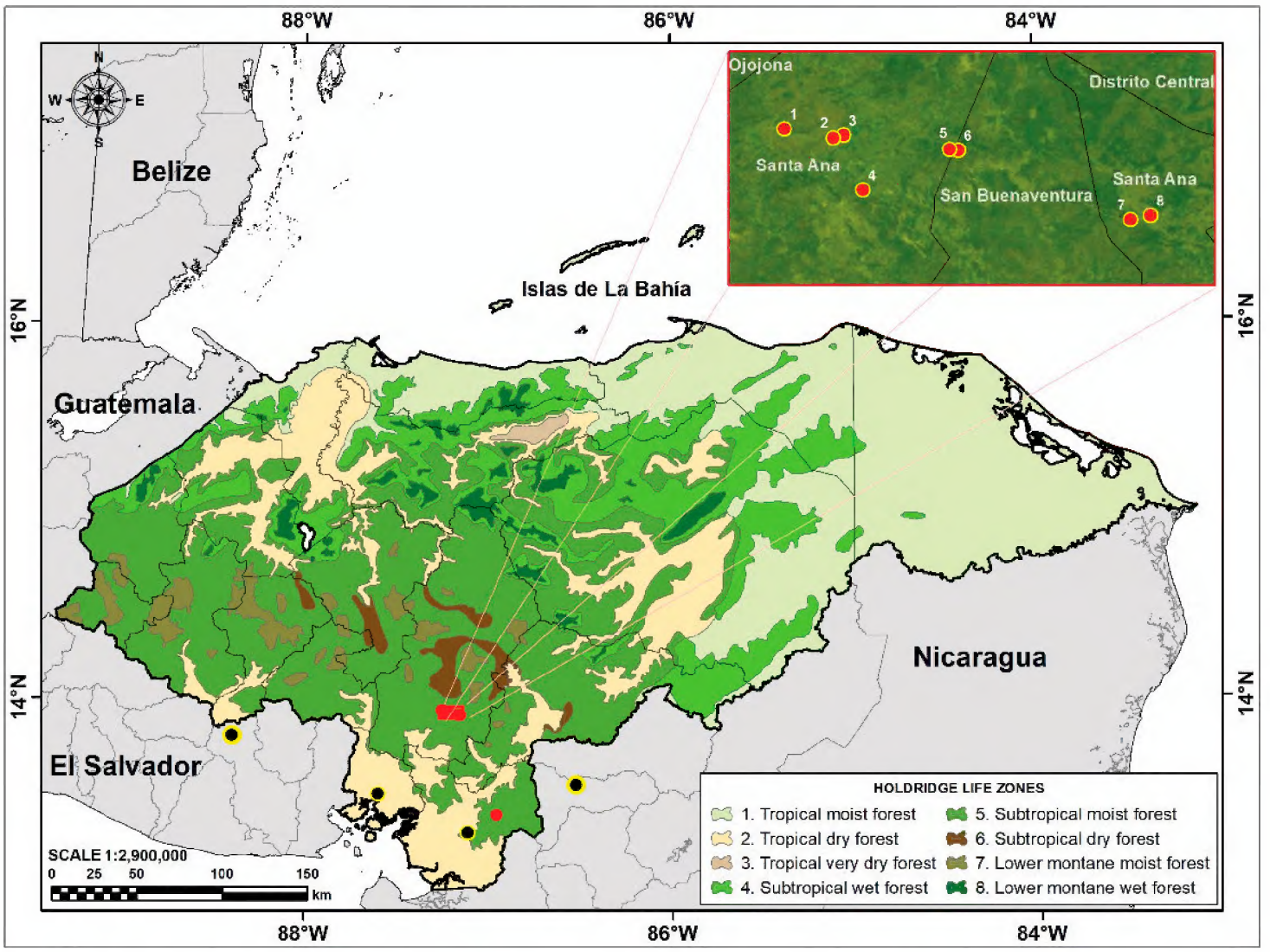

Figure 1. Distribution records of *Leptonycteris yerbabuenae* in Central America. Black dots indicate the only two known localities for Honduras, one for El Salvador, and one for Nicaragua. Red dots indicate the two new localities reported in this paper at Choluteca and Francisco Morazán departments. Sites of records at Francisco Morazán are indicated by numbers (top right). These are the same numbers included in Table 1 for the sites at locality 1. Map by Jorge Funez.

has been threatened by habitat conversion for agriculture, livestock grazing, urbanization, disturbance of roosts, loss of food sources through land clearing and human exploitation, and direct killing by human vandalism (USFWS 2007). Such threats persist and could even be increasing in some areas (USFWS 2013). In addition, the tropical dry forest is the most threatened ecosystem in Mesoamerica (Janzen 1988). Our objective is to report new records on distribution and habitat of the lesser long-nosed bat in Honduras, including a new elevation record for this species in the country.

Methods

We conducted bat surveys from 2012 to 2015 at several localities in Honduras, including La Anonilla, Cerro Chinchayote, Choluteca, and Cerro de Hula, Francisco Morazán (Fig. 1). We used an ANABAT SD2 detector for a total of 32 recording hours at 20 sites in Cerro de Hula in March, April, May, August, and November 2012. To determine the relative abundance of bat species, we followed Estrada-Villegas et al. (2010), in which the presence of a species during each 10-minute repetition counts as one bat, irrespec-

tive of the number of times it was recorded in that period (Girón et al. 2013). We used mist nets to capture bats at both sites, and also looked for dead bats at a wind power facility at Cerro de Hula. Surveys were conducted once a month from April to November 2012 at Cerro de Hula, and in March and April 2015 at La Anonilla. At the latter site we set six 12 m mist nets for 3.5 hours on two nights, and estimated capture effort (m of mist net * hours), and capture success (number of individuals/m*h).

We identified the bats and took standard measurements when possible. We also photographed each individual as vouchers. We kept four of eight lesser long-nosed bats found dead at Cerro de Hula frozen at Escuela Agrícola Panamericana Zamorano (EAP). Two lesser long-nosed bats from La Anonilla were euthanized by thoracic compression and intracardiac injection of chlorobuthanol following the guidelines of the American Society of Mammalogists (Sikes et al. 2016), and both specimens were preserved in 70% ethanol and deposited at the Museo de Historia Natural, Biodiversidad y Ciencia, Universidad Autónoma de Honduras en el Valle de Sula. The specimens were collected under permits granted to EAP by ICF (Instituto de Conservación Forestal), Tegucigalpa, Honduras.

We reviewed literature and databases to determine localities reported for the lesser long-nosed bat in Honduras. Recent papers by Turcios-Casco et al. (2020), and Saldaña Tapia et al. (2020) provided records of this species in the country as well as in Central America in general.

Results

We obtained 23 records of eight species of Mormoopidae, Vespertilionidae and Molossidae by acoustic means at Cerro de Hula. However, we were not able to identify any species of Phyllostomidae. Currently, we cannot identify members of this whispering bat family to species. Therefore, acoustic data were not useful for further verification of the species' presence. However, we identified and measured 18 lesser long-nosed bats from the two study localities (Table 1). Ten individuals from La Anonilla at Choluteca department were captured at one site in this locality, and eight specimens were found dead at eight different sites at Cerro de Hula (Table 1). The specimen from site 3 at Cerro de Hula constitutes the highest point registered for the lesser long-nosed bat in Honduras at 1710 m elevation (Table 1). We calculated a success capture rate of 0.01 lesser long-nosed bats/m*h.

The two new localities for the distribution range extension are represented by three individuals. The first one was an adult male from Francisco Morazán department, found at Cerro de Hula, Santa Ana Municipality, 20 km south of Tegucigalpa (13°55'04"N, 87°09'13"W; 1710 elevation). This individual was collected on 30 April 2012 by José M. Mora (EAPZ 155, specimen project number). Two individuals from Choluteca department were collected by Mario R. Espinal at La Anonilla, Cerro Chinchayote, Corpus Municipality (13°23'14"N, 86°57'19"W; 1240 elevation). One adult male was captured on 18 March 2015 (MUVS-V-01305), and the second one on 07 April 2020 (MUVS-V-01306).

Table 1. Individuals of the lesser long-nosed bat (*Leptonycteris yerbabuenae*) detected at two localities (L): eight sites (S) at Cerro de Hula, Francisco Morazán (locality 1), and one site at La Anonilla, Chinchayote, Choluteca (locality 2), Honduras. FP = forest patch; OP = very open pastureland; P/fr = pastureland with forest remnants close by; PF = pine forest.

L/S	Coordinates	Elevation (m)	Habitat	Date	Sex	Forearm (mm)	Weight (g)
1/1	13°55'29"N, 87°13'56"W	1480	P/fr	03 April 2012	Male	54.1	_
1/2	13°56'23"N, 87°14'15"W	1560	OP	12 April 2012	Male	54.0	_
1/3	13°55'04"N, 87°09'13"W	1710	P/fr	30 April 2012	Male	52.3	_
1/4	13°55'00"N, 87°09'33"W	1660	FP	04 May 2012	Female	54.0	_
1/5	13°56'08"N, 87°12'22"W	1550	P/fr	29 May 2012	Female	52.1	_
1/6	13°56'29"N, 87°15'13"W	1630	OP	16 July 2012	Male	54.0	_
1/7	13°56'20"N, 87°14'25"W	1590	OP	26 July 2012	Female	53.5	_
1/8	13°56'09"N, 87°12'31"W	1540	p/fr	17 August 2012	Male	56.0	_
2/1	13°23'14"N, 86°57'19"W	1240	PF	18 March 2015	Male	56.4	30
2/1	13°23'14"N, 86°57'19"W	1240	PF	18 March 2015	Male	55.8	31
2/1	13°23'14"N, 86°57'19"W	1240	PF	07 April 2015	Male	55.4	31
2/1	13°23'14"N, 86°57'19"W	1240	PF	07 April 2015	Male	56.8	32
2/1	13°23'14"N, 86°57'19"W	1240	PF	07 April 2015	Male	56.2	35
2/1	13°23'14"N, 86°57'19"W	1240	PF	07 April 2015	Male	55.8	33
2/1	13°23'14"N, 86°57'19"W	1240	PF	07 April 2015	Male	54.4	33
2/1	13°23'14"N, 86°57'19"W	1240	PF	07 April 2015	Male	58.1	32
2/1	13°23'14"N, 86°57'19"W	1240	PF	07 April 2015	Male	58.1	32
2/1	13°23'14"N, 86°57'19"W	1240	PF	07 April 2015	Male	53.6	32
2/1	13°23'14"N, 86°57'19"W	1240	PF	07 April 2015	Male	56.4	30

The two sites reported here as new localities for the lesser long-nosed bat are at a similar distance from Nacaome, the first locality reported for this species in Honduras: 62.2 km to Cerro de Hula, and 70.9 km to Chinchayote (which is 68.3 km from Cerro de Hula; Fig. 1). However, Santa Ana de Yusguare, the second known locality of the lesser long-nosed bat in Honduras, is located only 19.8 km from Chinchayote. The dominant vegetation at this locality is pine forest (Fig. 3). The habitat at Cerro de Hula is a highly disturbed area with scant scattered natural vegetation. The area is used for agriculture, cattle ranching, and some human housing (Mora and López 2010). The area occupied by the wind power facility includes some small patches of forest and remnant natural vegetation. However, the most remarkable aspect is that both new localities belong to the Subtropical Moist Forest Life Zone following Holdridge´s classification (Holdridge 1967).

Discussion

The rarity of the lesser long-nosed bat in Central America is one of the reasons that this species is considered Near Threatened (NT) by the IUCN (Turcios-Casco et al. 2020). The relative abundance of this species at a wind facility at Cerro de Hula in the Francisco Morazán department in Honduras was low (Girón et al. 2013). However, it was relatively common at La Anonilla at southern Honduras where we captured 10 individuals with a success capture rate of 0.01 individuals/m*h. It is still unclear how common this species is in the country. Its distribution includes

Figure 2. An adult male lesser long-nosed bat (*Leptonycteris yerbabuenae*) from La Anonilla, Cerro Chinchayote, El Corpus, Choluteca department, Honduras. Photo: MRE.

highlands in Honduras as well, as shown here in several records at Cerro de Hula including one at 1710 m a.s.l. (Table 1), indicating that the species has a wider distribution than previously thought. A recent iNaturalist record from 02 March 2019 https://www.inaturalist.org/observations/41662024 documents a lesser long-nosed bat captured at El Paraíso department, some 70 km east of Cerro de Hula. Previously, it was only known from southern Honduras in the departments of Choluteca and Valle (Turcios-Casco et al. 2020). These authors detailed the presence of this species in Honduras and noted the records of five specimens from Nacaome, Valle (TCWC 49747–49749, TTU 61087–61088) and one from Yusguare, Choluteca (ZD 1999.194). Both localities consist of dry forest habitat, but both here and elsewhere in Honduras, bat sampling efforts have been very low (Mora et al. 2016). Bat sampling has intensified in Honduras in the last 10 years due to new development activities, particularly of wind power facilities. New demands for knowledge, together with a new generation of field biologists, are driving research initiatives of Honduran bats (Mora 2018). A third record for the lesser long-nosed bat in Honduras from Francisco Morazán was included in fig. 2 by Saldaña-Tapia et al. (2020), referring to an additional iNaturalist record https://www.inaturalist.org/observations/20857871 (O. Saldaña-Tapia, pers. comm.), but additional data were not provided.

Figure 3. Pine forest at La Anonilla, Cerro Chinchayote, where 10 lesser long-nosed bats (*Leptonycteris yerbabuenae*) were captured in 2015. El Corpus, Choluteca department, Honduras. Photo: MRE.

Leptonycteris yerbabuenae inhabits caves and mines, often in clusters of hundreds of individuals (Reid 2009). Its main habitat is dry forest and thorny scrub; however, it also inhabits pine-oak forests (Cole and Wilson 2006). Dry forest is the main habitat in southern Honduras (Valle and Choluteca departments). However, the two new localities reported here are located in the subtropical moist forest. The La Anonilla habitat where we captured this species was a pine forest in this life zone (Fig. 3). The subtropical moist forest life zone is more extensive in Honduras than the dry forest, and together with the dry forest covers more than half of the country (Fig. 1). This suggests that the lesser long-nosed bat has more habitat available for its survival in Honduras. Unfortunately, a considerable area within these two life zones has been altered by human activities (Mora 2017).

Even though food resources for this species are patchily distributed and the nectar is only seasonally available (Cole and Wilson 2006), the bat is able to survive in a relatively wide area. To do that it is possible that the lesser long-nosed bat times its movements and feeding to local flowering such it does with cacti and agaves in North America (Cole and Wilson 2006). Nevertheless, the lesser long-nosed bat visited flowers found in trees in disturbed habitats less frequently than trees found in undisturbed habitats, and as such, habitat disruption has a negative effect on this species

in tropical dry forest ecosystems as well as negative consequences for the plants they pollinate (Quesada et al. 2003). The fragility of mutualistic relationships between bats and plants is magnified in the case of the long-nosed bat because of their migratory habits. These bats depend not only on the plants in a given region, but also on a continuous supply of food along their migratory routes (Arita and Wilson 1987; Trejo-Salazar et al. 2016). Food plants were more important than climatic and topographic variables in shaping the distribution of *Leptonycteris yerbabuenae* who was influenced more generally by cacti, Agave and C3 plants (Burke et al. 2019). Therefore, climate change will likely affect this species as well as other nectar feeding bats as predicted by modeling of the impact of environmental change on the vegetation present within their distribution areas (Gómez-Ruiz and Lacher 2019). These authors pointed out that the reduction of suitable areas for Agave species will restrict the foraging resources available for nectar feeding bats, threatening the survival of their populations and the maintenance of their pollination services (Gómez-Ruiz and Lacher 2019). At the same time, the potential extinction of species such as *Leptonycteris nivalis* – and we add *Leptonycteris yerbabuenae* to that list – will likely have negative effects on the sexual reproduction and genetic variability of Agave plants, increasing their vulnerability to future environmental change (Gómez-Ruiz and Lacher 2019).

There is no evidence that migratory individuals of the lesser long-nosed bat reach as far south as Nicaragua. In fact, their behavior in Central America is basically unknown. Some individuals exhibit altitudinal migrations in search of their food in México (López et al. 2003). Thus, populations of long-nosed bats in Honduras are probably resident; there are shelters where they reproduce, food resources that they seek at night, and altitudinal migration can be expected. Although this species has been widely studied in Mexico and the southern United States (Frick et al. 2018), its behavior in Honduras is practically unknown. Studies regarding their food, shelter, and distribution in the country are needed.

Leptonycteris yerbabuenae, also called the tequila bat, is a key species for the tequila and mezcal industry. As such, it has been the focus of intense research over the last 20 years (Menchaca et al. 2020). These last authors claim that the close relationship between this bat and economically important plants has raised awareness of its importance as both a keystone mutualist, exchanging food for pollination, and a mobile link between habitats. However, the range of this bat extends beyond tequila production areas, and beyond national borders it also plays key roles as a pollinator and link between habitat areas. This means that such awareness, research, and conservation efforts should be an international goal, including populations in Honduras, to effectively protect the species, its local and migratory routes, and its habitats.

Conclusions

These new records for *Leptonycteris yerbabuenae* are important for several reasons. First, there have been very few records of this species in Honduras and Central America in general; in addition, there have been no recent records for this species

in Honduras at all. Second, this species was previously only known to occur at low elevations in Honduras (although up to 1291 m in Nicaragua; Saldaña Tapia et al. 2020). Now, we know that the long-nosed bat inhabits highlands in Honduras (up to 1710 m at Cerro de Hula, Table 1). Third, this is the first time that the species has been found in a different life zone besides the dry forest in Honduras, the subtropical moist forest. Finally, it appears that the species could be more common than was previously believed. As a result, several actions and strategies are recommended to help with the conservation of this bat in Honduras. Conservation strategies for the species should include protecting both refuges and migratory corridors (USFWS 1997). Protecting dry tropical forest, the main habitat of *Leptonycteris yerbabuenae* in western Mexico and Central America, is critical to maintain a viable population of this species given that the dry forest is in peril in Mesoamerica (Janzen 1988). Also, areas of subtropical moist forest must be protected for biodiversity conservation in Honduras. Such areas must include natural vegetation because the conservation of this species should focus more broadly on management of species richness of food plants, especially in tropical dry forests (Burke et al. 2019).

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